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DESIGNING A HEALTHY MENU PROJECT FOR INDONESIAN JUNIOR HIGH SCHOOL STUDENTS

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Abstract

Project-based learning (PjBL) is an appropriate learning model that can shape students' scientific, social and higher-order thinking. Implementing PjBL in education gives students the freedom to plan their own learning activities, conduct projects collaboratively and produce products. In a healthy menu project, PjBL can help students calculate their excess weight. The purpose of this study was thus to design a healthy menu that assists Indonesian junior high school students solve numeracy problems using obesity context. The method followed a design research type validation studies using observation and document reviews as data collection techniques. This study produced a learning trajectory that can help grade VII students solve arithmetic operations using obesity context through two activities. In the first, the students were asked to record their respective heights and weights, then use them to determine their body mass index (BMI) and body mass ratio (BMR). Then, the students confirmed their necessary daily caloric intake, and categorized their BMI and BMR results as underweight, normal, overweight or obese. In the second activity, the students developed healthy menus per their respective tastes based on their weight categories from the first activity. The study concluded with the students successfully producing healthy menus that they designed according to their calculated required daily caloric intake.

Keywords: Design Research, Healthy Menu, Obesity, Project Based Learning

Abstrak

Pembelajaran berbasis proyek (PjBL) merupakan model pembelajaran yang sesuai, yang dapat membentuk perilaku saintifik, sosial dan berpikir tingkat tinggi siswa. Melaksanakan PjBL dalam belajar mengajar memberikan kebebasan siswa untuk merencanakan aktivitas belajar, melaksanakan proyek secara kolaboratif, dan mampu menghasilkan produk. Melalui proyek menu sehat, PjBL dapat membantu siswa memecahkan masalah dalam menghitung kelebihan berat badan. Tujuan dalam penelitian ini adalah mendesain menu sehat untuk membantu siswa SMP dalam memecahkan masalah operasi hitung bilangan menggunakan konteks obesitas. Metode yang digunakan adalah *design research* tipe *validation studies*, dengan mengunakan observasi dan kajian dokumen sebagai teknik pengumpulan data. Penelitian ini telah menghasilkan lintasan belajar yang dapat membantu siswa kelas VII dalam menyelesaikan permasalahan berbasis proyek menggunakan konteks obesitas melalui dua aktivitas. Kegiatan pertama yaitu siswa diminta untuk menuliskan tinggi dan berat badan masing-masing. Selanjutnya siswa menentukan indeks massa tubuh (BMI) dan angka metabolisme basal (BMR) berdasarkan tinggi dan berat badan tersebut. Kemudian siswa diminta untuk menentukan kalori harian yang dibutuhkan serta mengkategorikan hasil perhitungannya ke dalam kelompok berat badan kurang, normal, berat badan berlebihan, atau obesitas. Pada aktivitas kedua, siswa membuat menu makanan sesuai selera masing-masing berdasarkan hasil kategori yang didapat pada aktivitas pertama. Kesimpulan dari penelitian ini adalah menghasilkan menu sehat yang telah dirancang sesuai dengan perhitungan asupan kalori yang dibutuhkan.

Kata Kunci: *Design Research*, Menu Sehat, Obesitas, *Project Based Learning*

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The international triennial report PISA has revealed contradictions in Indonesian students' success over the last two decades while giving an overview of Indonesia's education system (OECD, 2013;

2016; 2018). Notably, Indonesian students lack the ability to solve mathematics problems, such as those assessed in PISA tasks (Wijaya, Van Den Heuvel-Panhuizen, Doorman, & Robitzsch, 2014). This is because these mathematics problems require higher-order thinking, whereas the students' ability to model, problem solve and develop argumentation is poor (Indonesian Ministry of Education and Culture [MoEC], 2018; Megawati, Wardani, & Hartatiana, 2020; Sidik, 2019; Tanudjaya & Doorman, 2020; Zulkardi & Putri, 2020).

Indonesian students' weak performance in PISA tasks was one of the bases for the implementation of the 2013 curriculum, which aims for students to study in line with what has been tested at the international level (MoEC, 2018; Permatasari, Putri, & Zulkardi, 2018). Learning theory, which links mathematics to all stages of complexity, requires creating a variety of situations that are similar to students' everyday lives, commonly known as Indonesian Realistic Mathematics Education (PMRI; Nusantara & Putri, 2018; Putri, 2011; Roni, Zulkardi, & Putri, 2017; Zulkardi & Putri, 2019; Zulkardi, Putri, & Wijaya, 2020).

The 2013 curriculum requires teachers as facilitators to emphasize twenty-first century skills abbreviated as the four C's: critical thinking and problem solving, communication, creativity and innovation and collaboration (MoEC, 2018). Collaboration is one of the essential skills that students must have. They are supposed to collaborate together with those in the community, adjusting to multiple positions and responsibilities (Octriana, Putri, & Nurjannah, 2019). Students' collaboration can take place using Lesson Study for Learning Community (LSLC), a system that enhances the quality of learning and make it more meaningful (Arifin, 2017; Putri, 2012). Learning through LSLC creates a learning atmosphere through dialog and communication, and inspires and connects students with each other to build diverse learning situations (Sato, 2014). This is in line with Putri and Zulkardi (2019), who state that by implementing LSLC, students can collaboratively solve high-level problems called jumping tasks (Putri & Zulkardi, 2019). LSLC can also improve students' mathematics skills, including higher-order thinking (Situmorang, Putri, & Lelyana, 2020), reasoning (Octriana et al., 2019), problem solving (Kurniawan, Putri, & Sunaryati, 2020) and representation (Saskiyah & Putri, 2020).

To improve these mathematics skills, a suitable learning model is necessary, of which one is project-based learning (PjBL). PjBL is an appropriate learning model that can shape students' scientific, social and higher-order thinking behaviour. Implementing PjBL in teaching and learning gives students the freedom to plan their own learning activities, carry out projects collaboratively and produce products (Mahendra, 2017). The PjBL model can thus assist students in creating meaningful learning environments through iterative processes, such as asking, sharing, effective learning and reflection, so that learning becomes collaborative, student-centred and intertwined with real-world practices (Chiang & Lee, 2016).

Project-related research using LSLC has been successfully conducted in a variety of contexts, such as trade-in school cooperation (Sari, Putri, Meisinta, & Sunaryati, 2020), water-saving

techniques (Meitrilova & Putri, 2020), planting sprouts (Andini & Putri, 2020), electric accounts (Agustina & Putri, 2020) and making fruit salad (Rahayu & Putri, 2020). However, no learning project has yet examined the importance of choosing a healthy menu, particularly at school, given that students are more attracted to choosing fast food at school (Febriani & Sudiarti, 2019). Therefore, this study examines how school healthy menu projects can help reduce student obesity rates.

METHOD

This research followed a validation study design with three stages: preparing the experiment, conducting the experiment itself and completing a retrospective analysis (Gravemeijer & Cobb, 2006; Putri & Zulkardi, 2017). This research involved 32 grade VII students from SMP N 19 Palembang. While preparing the experiment, the researchers and model teacher designed a learning project using the context of obesity that included a student worksheet, lesson plan, grids, teacher instructions, observation sheet and student answer predictions. In addition, the researchers and model teacher designed learning activities using the LSLC system and discussed how the learning process should be implemented so that students can collaborate with each other.

Based on these preparations, the researchers and model teacher produced two project-based activities. The goal of the first activity was for students to determine their individual body weight and categorize themselves as underweight, normal or overweight, while the goal of the second was for the students to make healthy menus based on their weight category.

The experimental stage consisted of a pilot experiment and teaching experiment. The pilot experiment involved 6 grade VII students from SMP N 1 Palembang who were selected based on their differing mathematics levels (high, middle and low). During the pilot experiment, the researchers acted as model teachers and the maths teachers as observers, though they switched their roles again for the teaching experiment, so that they could assess how the learning process was performed. The teaching experiment itself involved 32 grade VII students from SMP N 19 Palembang who were divided into eight groups of varying mathematics levels (high, middle and low) by adjusting the cross-section seats between male and female students.

After the experimental stage, the retrospective analysis stage took place, where the researchers, model teacher and observers reflected on the lesson with the aim of knowing the strengths and weaknesses of implementing PjBL. Then, their critiques and suggestions were used to improve the quality of learning without offending the model teacher, as it reflected on the students' learning process and the effectiveness of the teaching materials that had been designed and implemented (Putri & Zulkardi, 2019; Widiadi & Utami, 2016).

The data were analysed descriptively by collecting observations and review documents in the form of a student worksheet. The researchers used observations to view the students' behaviour (reactions, attitudes, facial expressions, interaction processes and communication). Document reviews also in the form of a student worksheet consisted of a sharing task and a jumping task (Putri &

Zulkardi, 2019; Sato, 2014). In this study, the sharing task focused on calculating body mass index (BMI), body mass ratio (BMR) and daily caloric intake, and the jumping task asked students to design a healthy menu according to their required daily caloric intake.

RESULTS AND DISCUSSION

In this study, grade VII of Indonesian students produced a healthy menu based on their daily caloric intake requirements. The project's implementation involved small group learning at the pilot stage, and the development of the actual class learning project at the experimental stage.

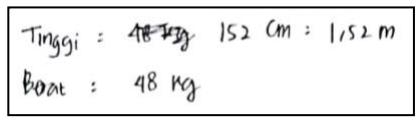
The pilot stage involved 6 students with high, middle and low mathematics abilities. This stage's results showed that the students' completion of the activities was still low, because their ability to multiply, divide and manage fractions was still lacking. Therefore, the researchers and model teacher decided to strengthen the students' prior knowledge while teaching the activities.

The teaching experiment stage involved 32 grade VII students from SMP N 19 Palembang. The learning phase began with reminding the students of their prior knowledge on multiplication, division and fractions. Then, the model teacher reminded them of mathematics socio-norms by using the game rule, that is, students should say "please teach me" if they did not understand a concept or procedure, and the teacher would then have to teach the student who had asked for help (Putri, Dolk, & Zulkardi, 2015; Sato, 2014). Thus, there was collaboration between students. Then, the model teacher divided the students into groups of four to work on the first activity.

During the learning process, the students collaborated with their groups that had been determined by the model teacher. Students who had low mathematics abilities were directed to work with higher-skilled group members, as the model teacher predicted that students with high abilities would easily complete the project, as well as some students with middle abilities. Activities in this PjBL process included several phases, namely Project Determination, Project Design Completion, Preparation of the Project Implementation Schedule, Settlement with Teacher Facilitation and Monitoring, Preparation of Reports and Presentations and Project Results (Educational Technology Division, 2006; Putri & Zulkardi, 2019; Thomas, 2000).

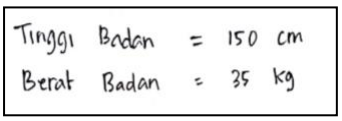
Project Determination

In the project determination stage, the students were asked to write down their weight and height (Figure 1). The first activity had the students measure each other's height and weight, which would then be used to calculate BMI, BMR and required daily caloric intake. For units of height, centimetres (cm) were converted to meters (m).



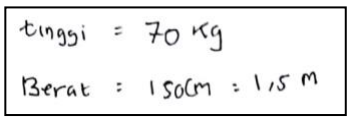
Height : 152 cm : 1.52 m
Weight : 48 kg

(a) The high abilities student (LNE)



Height : 150 cm
Weight : 35 kg

(b) The middle abilities student (RM)



Height : 70 kg
Weight : 150 cm : 1.5 m

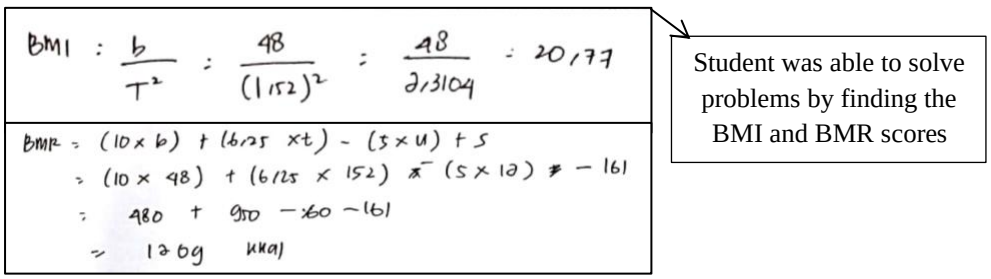
(c) The low abilities student (HD)

Figure 1. The results of the students' answers to question number 1

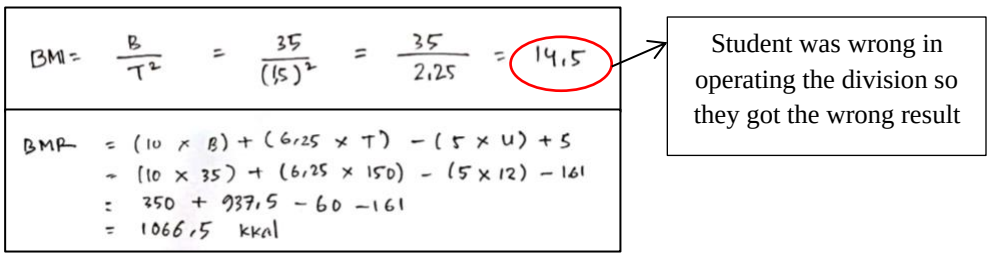
Based on Figure 1, the students regardless of mathematical ability successfully completed question 1, as seen in their ability to write their weight in kilograms (kg) and their height in meters.

Project Design Completion

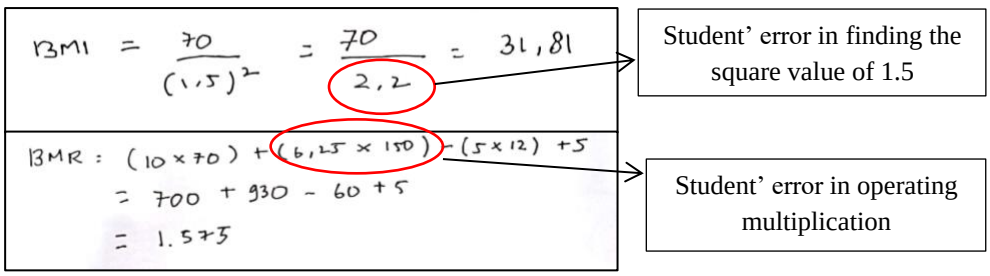
After the students recorded their respective weights and heights, they proceeded with the project's completion. In this phase, the students were asked to categorize their body weight into one of four groups: obese, overweight, normal and underweight. These weight categorizations corresponded to the students' BMI values. Then, the students determined their BMR to determine their necessary daily caloric intake (Figure 2).



(a) The high abilities student (LNE)



(b) The middle abilities student (RM)



(c) The low abilities student (HD)

Figure 2. The results of the students' answers to questions 2 and 3

Based on Figure 2, the high-level student LNE was able to apply the BMI and BMR formulas correctly. Unfortunately, in determining BMI, the student RM was wrong to divide, and thus got an incorrect final result. Meanwhile, the student HD was wrong to use a square value and multiply to determine BMR. This is in line with Nurjanah and Hakim (2019), who state that Indonesian students' ability to operate numbers is low, since they have a low understanding of number operations.

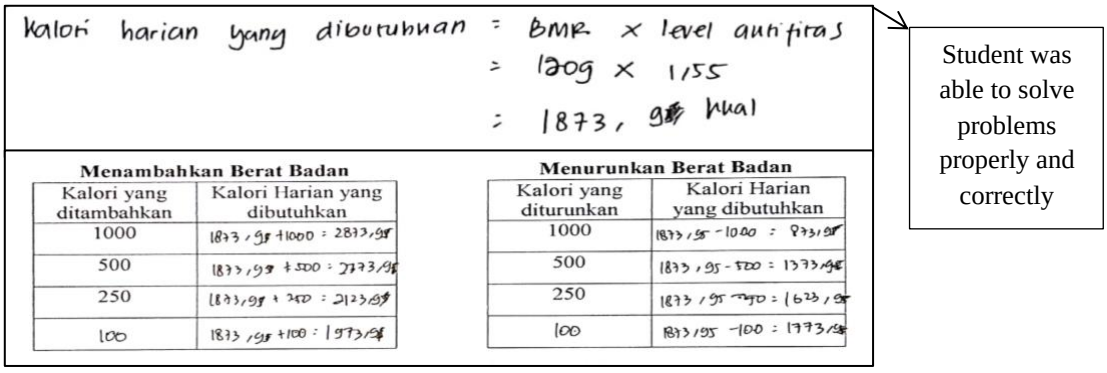
Preparing for the Project Implementation Schedule

The project implementation schedule preparation phase was completed so that the students could complete the given project on time. In this case, the project was planned to take 2 weeks and consist of two lessons and one presentation of the project results.

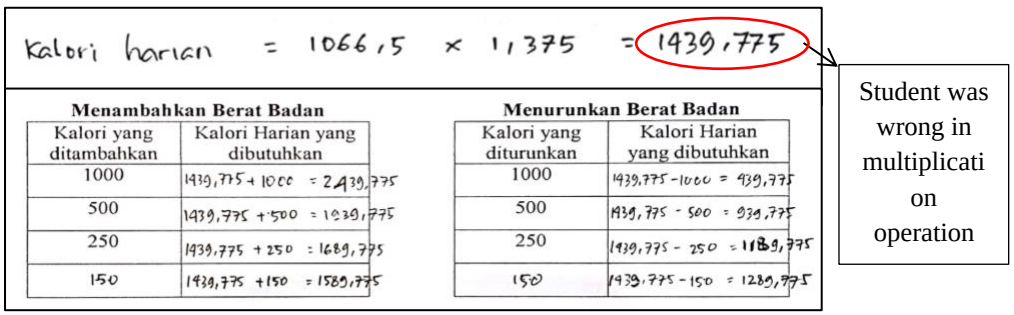
Settlement with Teacher Facilitation and Monitoring

The next phase was the completion of teacher facilitation and monitoring. Accordingly, the students were asked to determine whether their daily caloric intake needed to be reduced or increased so that they could achieve an ideal body weight (Figure 3). The students were also facilitated by a table that the teacher provided to determine their results.

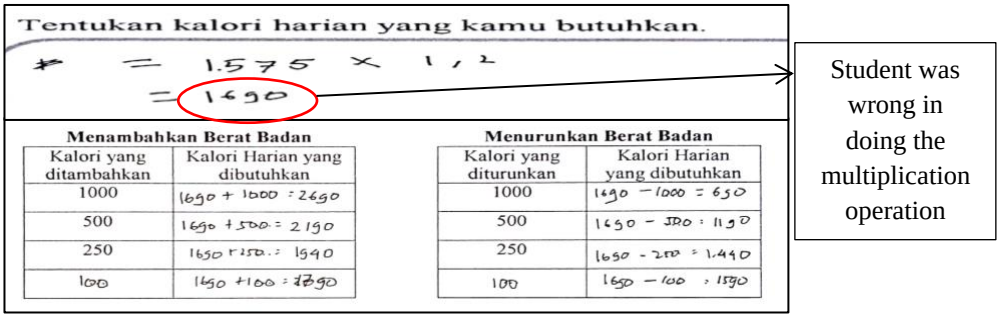
The student with high mathematics abilities (LNE) was able to solve the problems properly and correctly. She also determined the daily calories she needed and filled in the table by adding and subtracting the daily calories she wanted to consume (Figure 3a). The student with middle mathematics abilities (RM) was also able to determine the daily calories needed. However, this student was wrong to multiply certain numbers, which affected the results (Figure 3b).



(a) The high abilities student (LNE)



(b) The middle abilities student (RM)



(c) The low abilities student (HD)

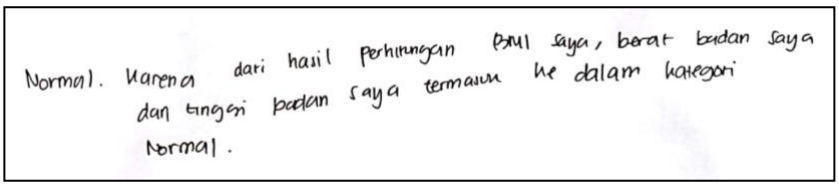
Figure 3. The results of the students' answers to questions 4 and 5

The student with low mathematics abilities (HD) was also wrong in multiplying when trying to determine required daily caloric intake due to misunderstanding the procedure (Figure 3c). Furthermore, Figure 3 shows that the students were able to apply the formula to determine their required daily caloric intake, even though the results of some students' computations were still wrong due to unnecessary multiplication. This shows that their algorithmic calculations were sequential, and that they tended to memorize procedures, which made their calculations less creative in solving the mathematical problems (Nurjanah & Hakim, 2019). On a similar note, Hakim and Sari (2019) express that there are indications that students with low numeracy skills will also have low skills.

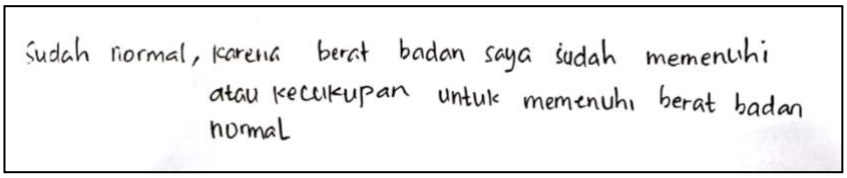
The teacher also monitored students who had difficulties solving the problems. Specifically, the teacher directed the students to ask for help from their groupmates who were able to solve the problems alone.

Preparation of Reports and Presentations

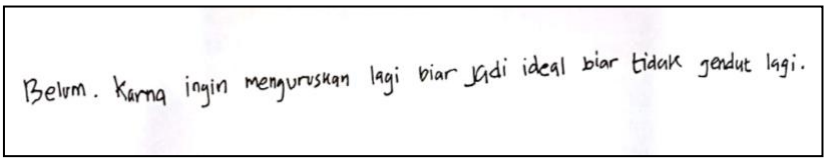
At this phase, the students were asked to draw conclusions from the previous phases and state their reasons for the conclusions they derived (Figure 4). Figure 4 shows that the students were able to draw conclusions about the calculation of their BMI, BMR, daily caloric intake and body type categorization, as well as include justifications for those conclusions. As in Thomas (2000), the students could control their own project by making decisions about what path to take. Furthermore, the teacher acted as a facilitator who interpreted the students' steps together to achieve mutual understanding by discussing the steps' implications so that the students could produce additional suggestions (Thomas, 2000).



(a) The high abilities student (LNE)



(b) The middle abilities student (RM)



(c) The low abilities student (HD)

Figure 4. The results of the students' answers to question number 6

Project Result

For the final evaluation phase, the students were asked to design a breakfast, lunch and dinner menu based on their required daily caloric intake to apply in their daily lives and achieve their ideal body weight (Figure 5). The student with high mathematical abilities (LNE) was able to properly design a healthy menu. She designed an 1873.9 kcal menu by dividing the number of calories she needed into three meals (Figure 3a): breakfast was 170 kcal, lunch 608 kcal and dinner 1095.9 kcal (Figure 5a). From Figure 5a, it appears that students with high mathematical abilities can think critically and creatively in determining what menu suits their caloric needs (Putri & Zulkardi, 2019).

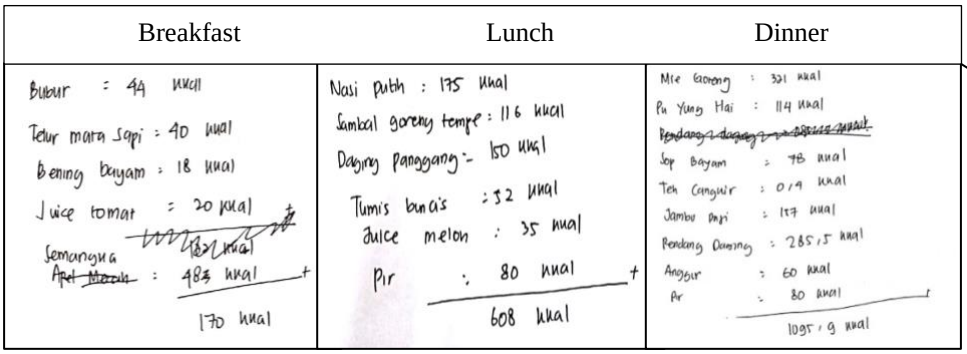
The student with middle mathematical abilities (RM) was also able to design a healthy menu according to the number of calories they determined that they needed. RM's healthy menu design consisted of 500 kcal for breakfast, 850 kcal for lunch and 589.7 kcal for dinner (Figure 5b).

The Low ability student (HD) was not able to design healthy menus properly and correctly. HD used the total daily calories needed to design each menu for, the morning, afternoon and evening menus based on the total number of calories needed per day (Figure 5c). Apart from that, HD also did not design a healthy menu according to the needs which included staple foods, like dishes, vegetables, drinks and fruits (Figure 5c). This could be because students did not understand the question well.

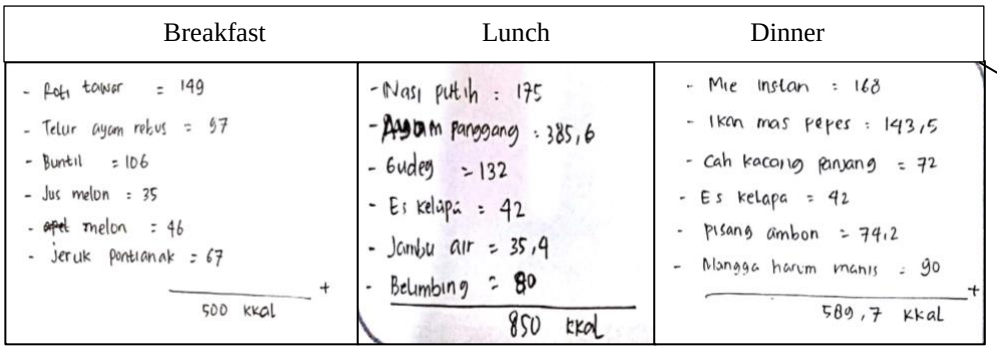
HD, a student with low mathematical abilities, was not able to design a healthy menu correctly, though. This student used the total daily calories needed to design a menu based on the total number of calories they needed per day (Figure 5c). However, apart from that, HD did not design a healthy menu that included staple foods like vegetables, drinks and fruit (Figure 5c). This could be because HD did not understand the question well.

Gultom and Roesdiana (2019) state that students who are not able to solve complex problems tend to have low mathematical reasoning skills. In addition, students who struggle to solve problems tend to be especially reluctant to properly those that they consider difficult (Putranti & Prahmana, 2018). Still, based on Figure 5, the students were able to use their creative abilities in making various

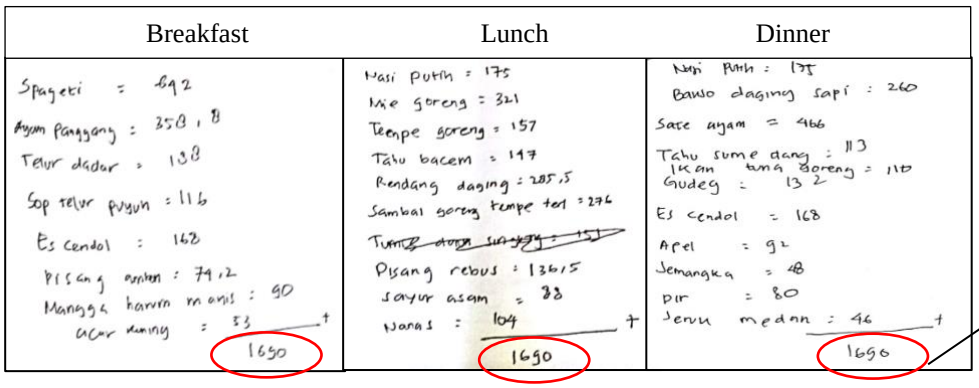
healthy menus according to their respective tastes. This study's mixed results show that through PjBL, students are able to use their creative abilities to solve mathematical problems (Tienken, 2010; Ummah, In'am, & Azmi, 2019).



(a) The high abilities student (LNE)



(b) The middle abilities student (RM)



(c) The low abilities student (HD)

Figure 5. The results of the student healthy menu design

CONCLUSION

This study produced a learning trajectory that helped students solve project-based problems regarding obesity through two different activities. In the first, the students were asked to record their respective heights and weights and use them to determine their BMI and BMR. Afterwards, the students calculated their required daily caloric intake and categorized themselves as underweight, normal, overweight or obese accordingly. The second activity had the students design a healthy menu

according to their respective tastes based on their weight category. Through PjBL, the students were ultimately able to use their mathematical reasoning skills and creativity to make unique healthy menus.

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